



## Aligning Feedback Literacy and Self-Agency to Professional Engineering Competency Standards

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### CONTEXT

Two contemporary skills that are currently not directly aligned and represented in professional engineering skills frameworks are feedback literacy and self-agency. Being feedback literate is essential for engineers, as it enables them to evaluate information critically and make meaningful improvements. Self-agency is also important as it promotes individuals' ability to identify and solve problems independently, and/or by collaborating with others, which will impact the success of their projects, teams, and/or organisations. During their studies, students are required to consistently develop their self-agency to succeed in their coursework, although the stakes are much lower than in a professional setting and tasks come with detailed descriptions and guidance. While these skills are not explicitly mentioned in any of the frameworks, their characteristic are often implied within various skill descriptors; however, they do not fully capture the importance of these skills.

### PURPOSE

The purpose of this exploratory study is to systematically review and perform a gap analysis to understand the extent to which feedback literacy and self-agency align against professional engineering competencies. This approach will provide a comprehensive understanding of strengths and areas for improvement, ensuring that graduates are equipped with the necessary skills and knowledge of feedback literacy and self-agency to enter the workforce.

### APPROACH

This study will systematically maps the interrelated themes between feedback literacy and self-agency against a newly developed framework of professional engineering skills (COMPASS), using a thematic analysis to map the competency alignment. By examining the outcomes of the mapping, the explicit and implicit alignment will be developed.

### ANTICIPATED OUTCOMES

It is expected that self-agency may be mapped to a further extent than feedback literacy. However, feedback literacy is unlikely to be mapped as a standalone competency against any other competencies without the presence of self-agency. A better integration of feedback literacy and self-agency can create a powerful framework for professional skills development and graduate preparedness.

### SUMMARY

Despite not being explicitly identified as skills in the professional competency framework, both feedback literacy and self-agency are fundamental to an engineer's personal and professional growth and development. This study highlights the importance of these missing skills, which may need to be embedded in the curriculum to better prepare students for their future careers in engineering.

### KEYWORDS

Feedback Literacy, Self-Agency, Professional Skills, Competencies, Graduate Readiness.

## Introduction

As the engineering landscape continues to evolve, the development of professional competencies is paramount to ensure that graduates are adequately prepared to meet the demands of the workforce. Although traditional engineering education has placed a strong emphasis on technical skills, there is a growing recognition of the importance of non-technical competencies (Hirudayaraj et al., 2021; Munir, 2021). Whilst the professional frameworks are comprehensive, they focus more on application rather than directly discussing skill attainment. Accordingly, skills such as feedback literacy and self-agency are dispersed through the frameworks rather than being an explicit skill. These skills are essential for continuous personal and professional development in enabling engineers to adapt to new challenges, improve their work and contribute meaningfully to their teams and organisations. (Gilbuena et al., 2015; Gewirtz, & Paretti, 2021).

This exploratory study aims to systematically map the alignment of feedback literacy and self-agency with professional engineering competencies through a newly developed Competency in Professional and Authentic Skills for Success (COMPASS) framework (Quince et al, 2025). This work expands on ongoing work by the authors on the development of COMPASS, and complex competencies within engineering education.

## Feedback Literacy and Self-Agency

Feedback literacy encompasses “the understanding, capacity and dispositions needed to make sense of feedback and use it to enhance one's work and learning” (Carless & Boud 2018). Whilst increasingly recognised in higher education as central to student success (Little et al. 2023; Lidfors Lindqvist et al., 2023, 2024) essential for engineers to make informed decisions and implement continuous improvements. Despite its importance, evaluative judgement and proactive engagement with feedback are not being emphasised in the current professional engineering frameworks.

Bandura, A. (2001) describes the core features of agency as “intentionality and forethought, self-regulation by self-reactive influence, and self-reflectiveness about one's quality of functioning...”. In other words, self-agency is an individual's ability to intentionally act, with autonomy, self-regulation and self-reflection (Bandura, A., 2001). In a professional context self-agency is the individual's capacity to take action, ownership and making decisions as they shape their professional identity within cultural and social contexts (Holland et al., 1998). This is vital for engineers to adapt to professional challenges, self-development, solve engineering problems, and contribute to their projects and teams (Gewirtz & Paretti, 2021). It is therefore important that engineering education prepares students for the complexities of professional practice. Despite being an important trait for successful engagement, there is limited literature that positions self-agency alongside professional competencies.

Neither feedback literacy nor self-agency are well-represented as competencies in the professional engineering skills framework or explicitly outlined in Engineers Australia Stage 1 Competencies (Engineers Australia, 2019) or the Washington Accord (International Engineering Alliance, 2021). While these skills are not explicitly mentioned in any of the frameworks, they are often implied through broader competencies such as such as lifelong learning and self-regulation (Carless & Boud, 2018; Bandura, 2001).

Better integration of feedback literacy and self-agency can create a powerful framework for professional skills development. By pairing the two, it allows individuals not only to demonstrate that they understand and know how to apply feedback but also how to take proactive steps to drive their own growth. There is an opportunity to perform a systematic mapping analysis of the existing competencies and their alignments with the principles of self-agency and feedback literacy to identify gaps. This analysis would provide a comprehensive understanding of the framework's strengths and areas for enhancement to ensure that graduates are equipped with the necessary skills to enter the workforce. Hence, this research

will identify strengths and gaps in the COMPASS framework. The goal is to ensure that graduates are equipped with the necessary skills and knowledge to thrive in their engineering careers.

## Professional Frameworks

The Washington Accord, established in 1989, is an international agreement among bodies responsible for accrediting engineering degree programs. It recognises the substantial equivalency of programs accredited by those bodies and advocates for the mutual recognition of engineering qualifications (International Engineering Alliance, 2021). This accord emphasises a set of graduate attributes and professional competencies that graduates must demonstrate to be deemed ready for the professional practice of engineering. The lack of explicit emphasis on these competencies can result in differences in perspectives between stakeholders (Quince et al., 2024)

Similarly, Engineers Australia's Stage 1 Competency Standards outline the knowledge, skills, and attributes expected of graduates from accredited engineering programs in Australia (Engineers Australia, 2019). These standards ensure that graduates are equipped with the necessary engineering foundations and professional skills to enter the workforce. They cover a range of competencies, including the ability to define and analyse engineering problems, design and develop engineering solutions and apply project management skills, among others (Engineers Australia, 2019).

In order to remain aligned with the current demands of industry and society, engineering education needs to extend beyond just technical knowledge. Problem solving does not occur in isolation. It relies on the broader set of non-technical skills. Without explicitly embedding or acknowledging these capabilities, educators risk overlooking what graduates actually need to thrive in real-world contexts. While Engineers Australia's framework is comprehensive, it shares similar limitations with the Washington Accord. Feedback literacy and self-agency provided are implied within various skill descriptors but are not given the prominence they deserve. This lack of explicit representation can hinder the development of graduates' abilities to engage in reflective practices and take proactive steps toward their own growth and development.

In response to these limitations, Quince et al. (2025) developed the COMPASS framework. This framework was derived from Washington Accord and mapped to EA stage 1 competencies to capture the non-technical skills attributes with enhanced language for stakeholders' accessibility. The 10 descriptors are defined as the ability to: *1. Define and Analyse Engineering Problems, 2. Design and Develop Engineering Solutions, 3. Methodologically Investigate Engineering Problems, 4. Assess Suitable Engineering and Digital Tools, 5. Solve Complex Engineering Problems with a Focus on Responsible and Sustainable Outcomes, 6. Apply Ethical Practices, 7. Work Independently and Collaboratively, 8. Communicate Through Various Mediums, 9. Apply Project Management Skills, 10. Engage in Ongoing Learning and Professional Development.* These have 35 corresponding sub-descriptors outlined in Table 1.

**Table 1: The COMPASS framework sub-descriptors adopted from (Quince et al. 2025).**

| Code | Skill Sub-Descriptor                                                              | Code | Skill Sub-Descriptor                                     | Code | Skill Sub-Descriptor                                                              |
|------|-----------------------------------------------------------------------------------|------|----------------------------------------------------------|------|-----------------------------------------------------------------------------------|
| 1.1  | Identify, analyse, and solve complex engineering problems supported by evidence.  | 5.4  | Consider environmental impacts in engineering decisions. | 8.2  | Communicate effectively with society.                                             |
| 1.2  | Solve engineering problems with sustainability and holistic perspectives in mind. | 5.5  | Understand relevant legal frameworks in engineering.     | 8.3  | Develop reports and presentations that respect cultural and linguistic diversity. |

|     |                                                                                                   |     |                                                                      |      |                                                                        |
|-----|---------------------------------------------------------------------------------------------------|-----|----------------------------------------------------------------------|------|------------------------------------------------------------------------|
| 2.1 | Design innovative engineering solutions to meet project needs.                                    | 6.1 | Adhere to relevant national and international laws and regulations.  | 9.1  | Apply financial decision-making to individual engineering projects.    |
| 2.2 | Develop solutions considering public health and safety.                                           | 6.2 | Demonstrate an understanding of diversity and inclusion.             | 9.2  | Apply management principles in individual engineering tasks.           |
| 2.3 | Develop solutions considering project lifecycle, costs, and societal impacts.                     | 6.3 | Uphold ethical standards and professional norms in engineering.      | 9.3  | Contribute to team projects with financial decision-making skills.     |
| 3.1 | Design experiments, analyse and interpret data, and synthesise information for valid conclusions. | 7.1 | Receive feedback, evaluate its relevance, and take necessary action. | 9.4  | Apply management principles to teamwork in multidisciplinary settings. |
| 3.2 | Use research methods to investigate complex engineering problems.                                 | 7.2 | Provide constructive feedback.                                       | 9.5  | Lead projects with sound economic decision-making.                     |
| 4.1 | Identify suitable modern tools and techniques, understanding their strengths and limitations      | 7.3 | Contribute effectively as a team member.                             | 9.6  | Manage multidisciplinary projects effectively as a leader.             |
| 4.2 | Select suitable modern tools and techniques, understanding their strengths and limitations        | 7.4 | Lead teams effectively.                                              | 10.1 | Undertake independent and lifelong learning to grow professionally.    |
| 5.1 | Evaluate the sustainability of engineering solutions.                                             | 7.5 | Perform self-directed tasks.                                         | 10.2 | Adapt to emerging technologies in the engineering field.               |
| 5.2 | Assess the socioeconomic impacts of engineering practices, decisions, and solutions.              | 7.6 | Collaborate in diverse and multidisciplinary environments.           | 10.3 | Develop critical thinking to navigate technological change.            |
| 5.3 | Analyse health and safety concerns in engineering practices.                                      | 8.1 | Communicate effectively within the engineering community.            |      |                                                                        |

## Methodology

This exploratory study systematically maps the interrelated themes between feedback literacy (as per Carless & Boud (2018) definition) and self-agency (as articulated by Bandura (2001)) against the COMPASS framework (Quince et al. 2025) of professional engineering skills, using a consensus to map the competency alignment in a structured matrix. The COMPASS framework consists of 10 descriptors and 35 sub-descriptors in Table 1.

## Mapping Process

The mapping process was conducted by aligning feedback literacy and self-agency with each of the 35 sub-descriptors in the COMPASS framework, using the alignment levels outlined in Table 2. This is an exploratory study, where the mapping was completed by the three authors. Each author has experience in engineering education and curriculum, with individual expertise in either feedback literacy, self-agency, professional competencies or professional experience. The combined experience makes them suitable for this initial exploratory mapping. It is acknowledged that this may introduce a potential of bias, influenced by their interpretation of the framework. To mitigate this, the mapping was conducted independently, followed by two rounds of consensus review to reconcile discrepancies and determine the final results. In the first round, when the three reviewers all agreed, the results reflect this rating. If two reviewers agreed, their majority view determined the results. Lastly, if all three reviewers disagreed, a

partial rating was assigned. This was because one reviewer had viewed the skill as fundamental, another as supportive and the third as having no direct link, as such a middle ground rating was used to reflect the mixed perspectives. In the second round, all three reviewers met to discuss discrepancies in their ratings, and consensus was achieved only when full agreement was reached among all reviewers. In future work, this process could be further strengthened by a larger panel of reviewers with a formalised consensus approach.

**Table 2: Description of alignment level and symbols used in the structured mapping.**

| Alignment Level      | Symbol | Description                                                                    |
|----------------------|--------|--------------------------------------------------------------------------------|
| Strong               | ✓✓     | The skill is fundamental in supporting the competency in the framework.        |
| Partial              | ✓      | The skill supports the competency in the framework but is not essential.       |
| Minimal/no alignment | -      | There is no direct link between the skill and the competency in the framework. |

## Results

The mapping of feedback literacy and self-agency against the COMPASS framework revealed varying levels of alignment across the 35 sub-descriptors. The results are presented in Table 3, using the predefined symbols: strong alignment (✓✓), partial alignment (✓), and minimal/no alignment (-).

**Table 3: Mapping of Feedback Literacy and Self-Agency against the COMPASS framework.**

| Code | Feedback Literacy |         | Self-Agency |         | Code | Feedback Literacy |         | Self-Agency |         |
|------|-------------------|---------|-------------|---------|------|-------------------|---------|-------------|---------|
|      | Round 1           | Round 2 | Round 1     | Round 2 |      | Round 1           | Round 2 | Round 1     | Round 2 |
| 1.1  | ✓                 | ✓       | ✓✓          | ✓✓      | 7.2  | ✓✓                | ✓✓      | ✓           | ✓       |
| 1.2  | ✓                 | ✓       | ✓           | ✓       | 7.3  | ✓✓                | ✓✓      | ✓           | ✓       |
| 2.1  | ✓                 | ✓       | ✓           | ✓       | 7.4  | ✓✓                | ✓✓      | ✓✓          | ✓✓      |
| 2.2  | -                 | ✓       | ✓           | ✓       | 7.5  | ✓✓                | ✓✓      | ✓✓          | ✓✓      |
| 2.3  | -                 | ✓       | ✓✓          | ✓✓      | 7.6  | ✓                 | ✓       | ✓           | ✓       |
| 3.1  | ✓                 | ✓       | ✓           | ✓       | 8.1  | ✓                 | ✓       | ✓           | ✓       |
| 3.2  | -                 | -       | ✓           | ✓       | 8.2  | ✓                 | ✓       | ✓           | ✓       |
| 4.1  | -                 | -       | ✓           | ✓       | 8.3  | ✓                 | ✓       | ✓           | ✓       |
| 4.2  | -                 | -       | ✓           | ✓       | 9.1  | -                 | -       | ✓           | ✓       |
| 5.1  | -                 | ✓       | ✓✓          | ✓       | 9.2  | -                 | -       | ✓           | ✓       |
| 5.2  | -                 | ✓       | ✓           | ✓       | 9.3  | -                 | -       | ✓           | ✓       |
| 5.3  | ✓                 | ✓       | ✓           | ✓       | 9.4  | ✓                 | ✓       | ✓           | ✓       |
| 5.4  | -                 | -       | ✓✓          | ✓       | 9.5  | -                 | -       | ✓           | ✓       |
| 5.5  | -                 | -       | -           | -       | 9.6  | ✓✓                | ✓✓      | ✓           | ✓✓      |
| 6.1  | -                 | -       | ✓✓          | ✓✓      | 10.1 | -                 | -       | ✓✓          | ✓✓      |
| 6.2  | ✓                 | ✓       | ✓✓          | ✓✓      | 10.2 | -                 | -       | ✓✓          | ✓✓      |
| 6.3  | -                 | -       | ✓✓          | ✓✓      | 10.3 | -                 | -       | ✓✓          | ✓✓      |
| 7.1  | ✓✓                | ✓✓      | ✓✓          | ✓✓      |      |                   |         |             |         |

The results shown in Table 3 highlight where feedback literacy and self-agency are most and least represented across the COMPASS framework. To further summarise the overall distribution, Table 4 presents the frequency of each alignment level across all competencies for both feedback literacy and self-agency in Round 1 and Round 2 of the consensus between the reviewers.

**Table 4: Overview of results alignment**

| Skill             | Round   | ✓✓ (Strong) | ✓ (Partial) | – (None) |
|-------------------|---------|-------------|-------------|----------|
| Feedback Literacy | Round 1 | 6           | 11          | 18       |
|                   | Round 2 | 6           | 15          | 14       |
| Self-Agency       | Round 1 | 13          | 21          | 1        |
|                   | Round 2 | 12          | 22          | 1        |

## Discussion

This study examined the alignment between feedback literacy and self-agency with the professional standard COMPASS through a two-round consensus process, offering a layered understanding of how these skills underpin engineering competencies. The primary objective was to identify gaps and provide insights into how these skills can be better integrated into engineering education. The findings support previous research by Carless and Boud (2018) on the importance of feedback literacy in professional development. However, the study extends this by highlighting the interdependence of feedback literacy and self-agency.

As shown in Table 3 and 4, self-agency was more consistently integrated across the framework compared to feedback literacy, with nearly half of the sub-descriptors demonstrating strong alignment. In contrast, feedback literacy tended to cluster within communication and teamwork related competencies, showing limited alignment in technical or project management domains. These patterns suggest that while both feedback literacy and self-agency are partially embedded within current professional engineering competencies, notable gaps remain that warrant further attention.

### Round 1: Using Logic-Based Mapping

In round 1, reviewers independently rated the skills alignment with the COMPASS framework and results were compared and determined through a logic-based method. This approach provided a structured, systematic baseline that identified skills perceived as either fundamental, supportive or minimal/not aligned. Feedback literacy was mapped as a fundamental skill (✓✓) for 6 of the 35 sub-descriptors. The strongest alignments of those were found within sub-descriptor 7 (*Ability to Work Independently and Collaboratively*), particularly in skills such as *receiving and providing feedback* (7.1, 7.2) and *teamwork* (7.3). Strong alignment was also observed across communication competencies (8.1, 8.2, 8.3), emphasising the connection between feedback literacy and communication practices.

Feedback literacy was found to be a supportive skill (✓) for 11 out of 35 competencies, however, it was not identified as essential to the competencies. The remaining 18 competencies in round 1 were considered to have no direct link with feedback literacy. There was limited alignment with more technical areas, such as *engineering tool usage* (4.1, 4.2) and *project management and finance* (9.1–9.5).

Self-agency, on the other hand, was identified as a fundamental skill (✓✓) for 13 of the 35 competencies, covering all sub-descriptors within Category 6. *Ability to Apply Ethical Practices* and Category 10. *Ability to Engage in Ongoing Learning and Professional Development*, and the majority within Category 7. *Ability to Work Independently and Collaboratively*. Out of 35 sub-descriptors, self-agency was considered to be supportive but not essential skill (✓) to have for 21 of these competencies. Only one category was considered not to have a link to the self-agency, which was sub-descriptor 5.5 *Understand relevant legal frameworks in engineering*.

### Round 2: Using Full Consensus via Discussion

Round 2 introduced consensus through discussion, where the reviewers revisited each rating collaboratively. This round underlined the importance of interpretive dialogue, critical reflection,

and justification, allowing for clarification of ambiguities and surfacing of underlying assumptions. These shifts reflected a deeper understanding that was only possible through discourse. Feedback literacy was agreed to remain mapped as a fundamental skill (✓✓) for the same 6 sub-descriptors as identified in round 1. However, multiple initial judgments were revised, particularly in cases where language ambiguity (e.g., terms such as *develop*, *evaluate*, *consider*, *assess*) made room for varying interpretations. Therefore, the revised mapping considered feedback literacy as a supportive skill (✓) for 2.2, 2.3, 5.1 and 5.4.

Self-agency was mapped as a fundamental skill for 12 of the 35 competency sub-descriptors, after agreement that simply performing a task independently does not necessarily indicate high self-agency, particularly if the task can be executed passively or without intentional engagement. Consequently, it was then considered supportive but not essential for 22 of the sub-descriptors. 5.5 remained as the only not related, due to its specific context.

Self-agency demonstrated a broader distribution of strong alignments across the COMPASS framework. It was strongly linked in skills related to *independent learning* and *adaptability* (10.1–10.3), *leadership* and *self-directed task management* (7.4, 7.5), and *ethical professional practices* (6.1–6.3). Again, only legal frameworks (5.5) showed minimal or no alignment with self-agency, which was agreed to be due to its specific context.

### Insights from the Consensus Discussion Process

A critical insight from the consensus discussion was the recognition of a distinction between minimum competency and high-quality performance. While many tasks could be completed with limited feedback literacy or self-agency, achieving excellence in these tasks consistently required well-developed capabilities in both areas. This distinction reframes feedback literacy and self-agency not merely as prerequisites for task completion, but as essential components for elevating outcomes. The limitation of this mapping is that it does not fully capture the value of these skills, as they can still significantly improve both the quality and efficiency of work. For instance, while feedback literacy enhances problem-solving and innovation enabling individuals to reflect on and adjust their approaches, it is not always a fundamental skill as an adequate outcome may still be achieved without it. Similarly, self-agency supports independent action and decision-making, but it may not be necessary for every task, particularly when instructions are provided.

The iterative consensus process also provoked conceptual reflections beyond the scope of the original framework. Notably, the reviewers identified the potential value of a new competency domain: *self-leadership*. Self-leadership is defined by authors as a collective competency required to deal with the complex and rapidly changing world of engineering encompassing self-agency, self-efficacy, self-regulation and feedback literacy. The notion of self in this context draws on Karp's (2013) definition of the self as "the human being responsible for the thoughts and actions of an individual." In this way, self-leadership must be internally driven, grounded in personal initiative and accountability.

In an engineering context the competency of self-leadership can be described as: Engineers ability to lead themselves through autonomous, responsible, and competent action in technical, individual and team-based settings. They must not just initiate action (self-agency; Holland et al., 1998) but also believe in their own ability to succeed (self-efficacy; Ponton et al., 2001), to ensure outcomes are executed well through careful management of self and strive for continuous improvement (self-regulation; Fryer & Elliot, 2012), by effectively engaging with feedback (feedback literacy; Carless & Boud, 2018).

Accordingly, engineers need more than just technical expertise to perform effectively in their roles (Sheppard et al., 2006). This suggests a direction for future iterations of competency models to explicitly incorporate metacognitive and intrapersonal capacities that are increasingly critical in dynamic professional environment (Crawley et al., 2011; Lappalainen, 2011; Marra et al., 2017)

For educators, the findings offer guidance for curriculum design and assessment strategies. Feedback literacy and self-agency in engineering education can be achieved through practical exercises, real-world projects and continuous assessment that encourage students to engage with feedback, reflect critically and act independently. Emerging engineering competencies such as resilient and innovation in solving open-ended problems through ethical and sustainable practices rely on a foundation of self-agency to drive growth and continuous improvement (Kulkarni et al., 2017). Adopting this approach helps to prepare engineers to adapt to emerging technologies and respond to societal needs to ensure that they remain responsive and resilient in the face of evolving challenges (de Campos et al., 2020).

An example of a pedagogical shift to support the development of feedback literacy and self-agency is presented by Lidfors Lindqvist et al. (2023 and 2024), where feedback is replacing traditional marks within formative sprints. The iterative development, peer feedback and active self-reflection and self-regulation directly supports the growth of feedback literacy and self-agency. Models such as this provide a tangible roadmap for embedding these skills in authentic learning environments.

The second round of consensus review was instrumental in moving beyond surface-level alignment to a richer, more context-sensitive understanding of how feedback literacy and self-agency may need to be emphasised within engineering education. While not uniformly fundamental across all competencies, these skills were consistently seen as enhancers of professional judgment, adaptability and innovation. Together with self-regulation and self-efficacy elements of self-leadership, their integration into curriculum and assessment practices can play a critical role in preparing graduates to be reflective and self-directed engineers equipped to navigate evolving challenges.

## Conclusion

In conclusion, this study highlights the critical role of feedback literacy and self-agency in professional engineering competencies. The recognition that these skills can significantly enhance quality and effectiveness of the professional competencies, even if they are not always fundamental for task completion, shifts the perspective of competency frameworks. By integrating these metacognitive and intrapersonal capacities, educators can foster a more adaptable, innovative and resilient engineering graduates. The proposed inclusion of these skills in curriculum design and assessment practices offers a pathway to better prepare students for the dynamic demands of the engineering profession, ensuring they are equipped to navigate future challenges with confidence and skill.

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